Robert L. Bates

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GEOLOGICAL EDUCATION

THE ASSOCIATION OF GEOLOGY TEACHERS

The ASSOCIATION OF GEOLOGY TEACHERS was founded in the Middle West in May, 1938. In November, 1951, it was organized as a national association, under which there are at present five organized regional sections: Central, East Central, Eastern, New England, and Far Western. A Southeastern Section will be organized in the near future. An annual meeting of the national association is normally held in the fall, and sectional meetings are held in the spring.

The purpose of the Association, as stated in its Constitution, is "to foster improvement in the teaching of the earth sciences at all levels of formal and informal instruction, to emphasize the cultural significance of the earth sciences, and to disseminate knowledge in this field to the general public."

Anyone concerned with geological education, formal or informal and at any age level, is invited to apply for membership. *Inquiries should be addressed to the national secretary:*

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EDITORIAL: PROSPECTING FOR IDEAS

Members of the Association of Geology Teachers and all readers of the *Journal of Geological Education* owe a debt of gratitude to William F. Read, Associate Professor of Geology at Lawrence College, Appleton, Wisconsin, and first editor of the *Journal*. To make the initial plans for this publication and to carry it successfully through its first three years of existence required vigor, imagination, perseverance, and an understanding of the problems and needs of geological education. That Professor Read was eminently fitted for the work is evidenced by the high quality of the six issues of the *Journal* published while he was editor.

Beginning with this issue a new editor takes up the task, to carry on the work for the next three years. It will be her earnest purpose to maintain the standards so ably set up by Professor Read and to do everything possible to make the *Journal of Geological Education* a useful instrument of the Association of Geology Teachers. To that end she bespeaks the cooperation of all members of the Association and readers of the *Journal*. Please do not hesitate to submit your own manuscripts for consideration and to tell the editor about colleagues of yours who could make worthwhile contributions. If you will open up the treasure houses of your own knowledge and experience and help the editor discover the resources of your colleagues we shall gather a rich store of ideas, which we can share in the pages of the *Journal*. Let us be prospectors together in the search for these ideas.

ANASTASIA VAN BURKALOW

JOURNAL OF GEOLOGICAL EDUCATION
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IN MEMORIAM: Ralph Eriksen Digman, 1920–1953*

Kurt E. Lowe
The City College of New York

Would any of us remember what we did on Sunday, December 20, 1953? We were most likely spending a quiet day with our families, perhaps planning and preparing for the impending Christmas holidays. Little did we realize that it was a day of tragedy and heartbreak in the town of Endicott, New York. It was the day Ralph Eriksen Digman died after a short, violent siege of poliomyelitis.

"Our Ralph," at the age of 33, was just entering upon the most promising and rewarding period of his career. The hard years of training and preparation for his life's work were behind him. His loved and loving family, consisting of Patricia Digman and three children (the oldest only seven years of age), gave meaning and substance to his work as geologist and teacher. With his usual enthusiasm and zest he was planning for an expanded program of geological training at Harpur College in new and bigger quarters ... The stage was lit, the orchestra struck up the first tune, the play was about to go on, when the curtain descended and with it silence and darkness.

But let us look back upon happier days.

Ralph was a bright student. In 1942 he graduated from Lawrence College at Appleton, Wisconsin, with a B.A. *cum laude*. As William E. Ford scholar at Yale University he completed his M.A. in 1943. Syracuse University awarded him the Ph.D. in 1949.

His love for teaching was kindled during his junior year in college, for he served as laboratory assistant in geology at Lawrence College from 1940 to 1942. This experience was followed by a teaching assistantship at Yale University (1943–1944). From 1944 to 1947 he was instructor in geoolgy at Wesleyan University, Middletown, Connecticut, where he was acting chairman of the department during the first two years. Armed with a Ph.D. he went to Lafayette College, Easton, Pennsylvania, as assistant professor in 1949. Finally in 1950 he was called to Harpur College of the University of the State of New York at Endicott, New York, to establish and direct a new department of geology. In this challenging position he

*Presented on April 2, 1954, at the fourth annual meeting of the Eastern Section of the Association of Geology Teachers, at Rutgers University, New Brunswick, New Jersey.

was about to harvest some of the fruits of his hard and devoted labors when he died.

Yet this was not all. There were the summer seasons and "spare" time which could not go to waste. Ralph found time and energy to act as instructor for the Civilian Air Patrol of the Army Air Force between 1943 and 1945, and to pursue geological field work. From 1943 to 1947 he studied the Triassic of Connecticut in the Guilford quadrangle. Some of his findings were published [1] in the *American Journal of Science* in January, 1950, and a joint paper with Harry M. Mikami on the Branford-Killingworth area appeared as an abstract [2] in the *Bulletin of the Geological Society of America* in December, 1950. After working during the summer of 1948 for the Ground Water Branch of the United States Geological Survey, Ralph began his part-time association as geologist with the New York State Science Service. Since 1951 he had been engaged in a county-by-county survey of limestones. Schoharie, Otsego, Albany, and St. Lawrence counties were included in his work. The Albany County report was nearly ready for publication when he died.

Ralph was not a "joiner" of organizations, preferring rather to be an active participant in a few, such as the American Geophysical Union, the New York State Geological Association, the Geological Society of America, and the Association of Geology Teachers.

I have saved mention of the Association of Geology Teachers for the last, because it is in this area that we feel his loss most keenly. I do not believe that we would be meeting here today as the Eastern Section nor that we would be able to point with pride at our national organization, had it not been for the untiring, enthusiastic, and selfless efforts of Ralph Digman. He, more than any other individual, was responsible for the organization of our Section at Washington in 1950 and, as its first president, for putting it on a firm footing. Similarly, he was the prime mover behind the establishment of the national organization at Detroit in 1951. As national secretary from 1951 to 1953 he made an ambitious dream of a nationwide organization of geology teachers come true.

We deeply mourn a departed colleague, geologist and teacher. Will you join me in a brief period of silent meditation in remembrance of a dear young friend and a wonderful human being.... We shall not forget you, Ralph.

1 Digman, Ralph, 1950, An exposure of the Triassic eastern border fault: Am. Jour. Sci., v. 248, p. 37–45.

2 Mikami, H. M., and Digman, Ralph, 1950, Geology of the Branford-Killingworth area, Connecticut (Abstract): Geol. Soc. America Bull., v. 61, p. 1486–1487.

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GEOLOGY AND MAN*

Chauncey D. Holmes
University of Missouri

In any final analysis, knowledge must be evaluated from the standpoint of its human significance, and this is especially true of scientific knowledge. Although for some persons mere possession of knowledge may sometimes appear as an end in itself, it is the integration of that knowledge into the person's total life experience that brings understanding and enrichment of life. This distinction often remains obscure to students, and teachers are prone to overlook it in their primary concern over getting students to learn the factual content of their courses. The attempt by the learner t integrate his knowledge is a natural, spontaneous reaction, and some degree of success is achieved without special effort in this direction. However, both published and unpublished opinions on this subject seem to show that much more attention should be devoted to this aspect of education; and there is much lack of agreement as to how it may be accomplished.

In many colleges the course in elementary geology is long enough to afford adequate attention to these more personal aspects of the science. In others, the requirements of the curriculum may be such that an additional course may well be offered that can develop the general theme of Geology and Man. In such a course the broad scope of geology is well known and taken for granted. Equally important, the fact that Man is a spiritual being as well as a physical being should be given broad and adequate consideration. Science and technology will continue to supply his physical needs whether or not he understands how or why. Of course his appreciation of the world about him can be enhanced by increased understanding of its resources, but his deepest satisfaction will come from the feeling of spiritual reassurance which the geologic record should help to provide. To view the present in its geologic perspective or setting can do much to lessen the feeling of spiritual insecurity and uncertainty because it suggests positive courses of thought and action. No other field of knowledge can give a rational four-dimensional view of Creation.

Scientific advancement has been phenomenally rapid in the past dec-

* A briefer discussion of this topic was presented at the thirteenth annual meeting of the Central Section of the Association of Geology Teachers, at Iowa State College, Ames, Iowa, on April 11,1953.

ade or so, and much besides scientific achievement has occupied the public mind during this interval. As a result, the chronic lack of general public understanding has been aggravated to a state of "extraordinary scientific illiteracy in America, even among intelligent, educated people," as one recent writer (Quimby, 1954) has expressed it. Out of this lack of understanding has grown resentment. Even while the novel scientific luxuries of yesterday have become the necessities of life today, public suspicion of science and scientists is now stronger than it has been in many decades (Larrabee, 1953).

To help solve this paradoxical situation, geology as a science is favorably situated. On the one side it includes the basic principles of all the other physical sciences; and on the other, it is interwoven with the fundamental problems of human origin and existence. The geologic record is an authentic account of the stages of creation. Creation by evolution must be treated with respect, but it need no longer be kid-glove-handled as a theory. The fossil record and other basic geologic data leave no doubt that evolution is a fact, even though its precise mechanism or *modus operandi* is still a matter of uncertainty and of continuing investigation. The present writer believes that the roots of much popular suspicion of science still lie, as they have lain for at least a century, in this area of science with which geology is so deeply concerned. Responsibility for meeting the present public need in this area therefore rests largely with geologists, and especially with the teachers of geology.

It should be said that integration of knowledge into a satisfactory and harmonious interpretation of human environment is a personal and individual matter. Each student must be allowed and encouraged to do this for himself. The teacher can present the facts and explain their significance as that teacher sees them; and it is hoped that the teacher himself has achieved a wholesome and adequate philosophy of life. The student can be expected to know the facts of the geologic record; but, for example, the student's right and freedom to reject what he may call the "doctrine of evolution" as a personal belief, if he so chooses, must be scrupulously respected.

Each teacher probably has his own techniques for meeting situations of this kind, and may sometimes have occasion to follow these subjects further, either in or out of the classroom. Not all of the thoughts outlined in the following paragraphs can be used on all occasions, but they are presented in order to indicate the possible, and perhaps desirable, scope of a course that treats particularly of Geology and Man.

Many excellent suggestions are available in recently published works,

of which three deserve special mention. One of these is Broom's *Finding the Missing Link* (1951), which deals somewhat informally with the numerous recent discoveries of early human or near-human remains in South Africa. Some paleontologists tend to ignore the possible significance of the South African material (which includes various vertebrate groups) because of its uncertain stratigraphic position. But author Broom points out the basic principles on which sound interpretation must rest, and he presents the fossil evidence of the probable course of human development from prehuman ancestry with great sincerity and without the inhibitions and facetiousness sometimes found in popular scientific literature.

Another important volume is *The Meaning of Evolution* by Simpson (1949). Besides being as objective as Broom's book, Simpson's work ventures further into the philosophical implications of evolution, mostly with well-reasoned conclusions. However, the present writer cannot agree with the author's apparent verdict that the course of evolution might just as well have produced almost any other assemblage of life forms as that which now exists, or that the known facts are inconsistent with the concept of an overall "plan" of creation. The facts by themselves cannot be made either to prove or to disprove the reality of such a "plan."

Much reliance is currently being placed on calculated statistical probabilities in which heredity or evolutionary factors are assumed to have moved in absolute random fashion, and we may feel free to evaluate the results in the light of the assumptions made. The assumption of randomness is equivalent to assuming that the procedure is chaotic, devoid of order, which is philosophically unacceptable. On many past occasions the term chaos (perhaps more often implied than expressed) has been used to designate the realm of existence that lay beyond the known, and it merely designates "an order which is not yet understood." As understanding has progressed, the realm of "chaos" has diminished.

Until absolute randomness of heredity factors can be demonstrated beyond question, we must conclude that evolution operates according to a yet-to-be-discovered order. The conclusion that Man's advent on the Earth is a fortuitous development therefore rests on insecure ground; and the fact remains that Man's development *is* the culmination of an unbroken sequence whose beginning antedates the earliest geologic record. This is what *has* developed; and to frame it in terms of statistical probability does not remove the ground from which we may, and must, ask *why*. Man, with his freedom of choice, his individual personal responsibility for his choices, and his capacity for unlimited spiritual growth, is the only known part of Creation that can contemplate these matters and strive toward an

intellectually satisfactory interpretation of them. There is no valid scientific or philosophical reason against the view that the purpose or plan of Creation, at this stage, is to do just what it does: to afford an environment in which unlimited individual spiritual growth can go on.

Genesis and Geology by Gillispie (1951), the third book referred to, traces the changes in religious interpretation of nature made necessary by the growth of geological knowledge from the days of Werner and Hutton. Gillispie is a historian, and geologists may find the book a little more difficult to read than either of the other two. Gillispie cites an earlier writer's observation that the English people have always shown a marked tendency to seek spiritual significance in their material possessions, and this characteristic provided a rich background for the inevitable conflict in which the growing science gradually displaced untenable religious interpretations. The conflict was largely among geologists themselves, inasmuch as many geologists of those days either held official positions in the Church or were closely affiliated with it.

Nearly a hundred years have passed since Darwin's *Origin of Species* (1859) showed with such embarrassing clearness the positive need for a better ecclesiastical interpretation of Nature, including Man. Yet today the unbiased but informed observer can perceive that much modern religious doctrine still ignores the one Record which the Creator Himself wrote rather than dictated. What has been said about popular thirst for scientific knowledge in itself (Larrabee, 1953) is equally true of the desire for aid in seeking its religious significance. If the help of qualified leaders is denied, seekers will turn to "cranks and faddists." An intellectual vacuum cannot remain static.

Philosophically considered, creation is an effect that requires an adequate, coexistent, and sustaining cause. All scientists would do well to realize that this Cause, like the spiritual beings that they are, is not among the electrons and atomic nuclei which in scientific literalness seem to be the ultimate; and that both scientists and non-scientists live in a world in which "poetry and politics" are among the realities of life (Larrabee, 1953). If we could comprehend how intimately and inseparably Cause and Creation are associated, the scriptural observation that "He is not far from any one of us" would have real meaning. Thus geology borders closely on the most intimate phases of the life of Man.

Doubtless most teachers feel more at home in dealing with the various phases of our material resources, for with these in their natural environment geology has the broadest and most direct concern of all the sciences. It is here in particular that Man's material welfare is involved, and that

public awareness and interest are needed. A continuing supply of the metals and fuels that have made modern civilization possible is popularly taken for granted, and yet it has always been an inescapable fact that the supplies of these are definitely limited. Recently the fact has come to light that the limits of some of these resources are closer than we had thought. Within the last few years a realistic reappraisal of our coal reserves shows that they are only about one tenth as great as had been supposed even as late as 1947 (Putnam, 1953). Moreover, the tempo of consumption of fuels and of many metals is still rising sharply.

Popular logic often supports the belief that adequate substitutes for exhausted non-renewable resources will always save us from the necessity of caution and foresight in the use of these resources. But in many cases the particular substitute is manufactured from raw materials already as limited as the commodity to be replaced, as for example, various plastics from petroleum. Reliance upon technology to save the day is likewise a prime source of popular assurance. Thus our petroleum resources already have been extended immensely in terms of years and horsepower. So long as this continues to happen, statistics support the reasoning one hundred per cent. But a single failure would make the whole structure collapse; and that one failure is eventually inevitable. Geologists as well as technologists face a serious responsibility not only to search for further resources, both old and new, but also to foster public awareness of future prospects. Willing and intelligent popular support for the project is vitally necessary.

Exhaustion of our power resources rather than of our metals seems to present the crucial problem. Even counting atomic fuels at a high value, well-informed persons (Daniels and Morgan, 1954) are convinced that within the next 200 years, a span of time no longer than has elapsed since the days of George Washington, our pattern of existence will have undergone radical change; and that "this generation would be negligent of its duty to posterity" unless we heed the approaching crisis. However, from the sheer inertia and momentum of our presently established economic order, we seem destined to continue the multiplication of our power-consuming gadgets for another generation or two at least. But when the declining phase of our power-based civilization at last sets in, the nation that controls the greatest power potential will have a decisive advantage. That day is still well in the future; but as it dawns, will an uninformed public rebel at making any sacrifice of its "right" to squander our remaining resources in such enterprises as faster and more furious highway speed, and in trips to the Moon and Mars?

Mankind has inhabitated this planet for at least a million years–a geologically brief time – and our continuation through some future millions of years, doubtless with some evolutionary changes, is a geologically reasonable prospect. But the rate at which we are using upNature's stored reserves of mechanical power in maintaining the comforts of our civilization makes the present age unique in the history of the Earth. Assuming that present trends continue, we shall have used up in scarcely more than 500 years the energy resources Nature has accumulated through the last 500 million years and more. As Hubbert (1949) has stated, this "can only happen once, and the historical events associated with this release [of stored energy] are necessarily without precedent, and are intrinsically incapable of repetition."

Future generations will face the problems outlined in the preceding paragraphs. Of more immediate concern is the problem of adequate ground water supplies to serve not only our traditional household and municipal needs but also our growing industrial plants. If any proof is needed that "cranks and faddists" can easily acquire a public following, popular reception of the recent book *Henry Gross and His Dowsing Rod* (Roberts, 1951) should supply that evidence. In this field, however, non-scientific beliefs and superstitions have long held sway, and in past ages the divining rod has been used for such diverse purposes as locating hidden treasure, detecting criminals, and finding lost articles (Ellis, 1917). Belief in the powers of the device is generally held with the tenacity of solemn religious conviction. Especially among adults, converts to a better understanding of ground-water occurrence are generally few. Here one may often see the truth of the old adage: "A man convinced against his will is of the same opinion still."

Water shortage has appeared recently in many regions that had been thought to have inexhaustible supplies, the thought perhaps having been encouraged by the fact that ground-water occurrence cannot be observed directly and therefore, to many people, has remained more or less a mystery if not a supernatural phenomenon. By some persons, news commentators not excluded, the shortage has been attributed to decline in the total amount of annual precipitation; but the chief factor is increase in the amounts withdrawn. As with our present rates of consumption of fuels and metals, greater quantities of water are now being used. In 1950, household and municipal totals averaged 1100 gallons per person per day (including both ground and surface water) (MacKichan, 1951).

Related to both water and hydroelectric-power supply are the extensive systems of dams being built along many of our rivers. The program of river

"improvement" began before the full consequences of interfering with a a graded river system were fully understood. It should become a matter of general public knowledge that building a dam along such a drainage system represents a drastic modification of the natural functioning of that system; and that it may possibly soon entail the necessity of artificially increasing the channel efficiency along many, if not all, segments of the river course. Because the ultimate cost of any such program may therefore greatly exceed that of the immediate engineering project of dam building, public knowledge of these aspects of river control is needed in order that the merits of a project can be more thoroughly understood. If Emerson were writing his essay "Compensation" today, he would find many additional illustrations in support of his thesis.

Among the visual aids on the subject of river development is a film entitled "Hoover Dam," produced by the U. S. Department of Interior presumably to educate our people regarding this type of improvement of our country. It is an admirable record of stupendous engineering achievement carried out with great technological skill under the handicaps of rough, desert terrain in a remote area. In the thrilling entertainment, even a geology teacher may not notice that almost no reference is made to the need for preliminary geological surveys and detailed investigation of site. Neither is the viewer's attention called to the problem of silting by that great sediment-laden river. There is, however, the assumption that everyone will rejoice that now, for the first time in the course of Creation, the mighty Colorado is under control, – conquered (?!). The teacher can supply the geologic perspective as needed for his particular class.

We often hear students remark: "I wish I had had my course in geology before I went to Glacier NationalPark last summer," and "Now as I drive through the country I keep wondering what kinds of rocks are in the road cuts, and what makes the hills that shape." Such comments reveal the deep-seated need for contact with the unspoiled natural environment from which modern civilization keeps large numbers of persons almost completely insulated. It is a part of what Olson (in Butcher, 1949) describes as "a spiritual necessity, an antidote to the high pressure of modern life, a means of regaining serenity and equilibrium." The need for these experiences is largely subconscious, but it is a genuine need nevertheless. Herein lies one of the great and essential services that our National Park system can and does render, but a little expert guidance in advance of trips to our parks does much to enhance their value. State parks and many non-park areas offer much the same opportunities, and even the required field trips in the average elementary course are not entirely devoid of this

element of re-creation. The instructor too intent on the "scientific" aspects of his mission may inadvertently submerge the more subtle effects of this kind, which any field observation should afford.

In summary, a guiding principle, paraphrasing a great teaching, may be suggested for the elementary course that has time enough to develop these themes, and for the special course stressing the human aspects of the science: Geology was made for Man, and not Man for Geology.

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INTEGRATED SCIENCE AT HUNTER COLLEGE

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In this age of increasing importance of science in everyday life there is a growing dissatisfaction with the traditional science courses offered to non-science students. This dissatisfaction ranges from James B. Conant and other educational leaders on down to the instructors in the classrooms and to the students themselves. The principal complaint is that those students who take the usual required year do not gain an understanding of the meaning of science. In the traditional first course in physics or chemistry, for example, the student solves equations, memorizes symbols, formulas, and laws, and gains some experience in observation, in reasoning, and in handling specialized apparatus. Such a course provides an essential foundation for further work in that subject. But the non-science student takes only the one year, or even a half year. From it he gains little understanding of the scope, the methods, and the interrelations of the various categorized sciences; nor does he become aware of the problems, the accomplishments, the hopes, and the personalities of scientists.

Since many of our leaders in world affairs and in everyday life come from the non-science divisions of our colleges, and since science will and should play an increasing role in the affairs of man, it is imperative that these leaders gain a better understanding of the meaning of science.

With such considerations as the above in mind, President George N. Shuster of Hunter College asked the chairmen of our science departments to try to improve the situation in our college. Professor Abraham Raskin, who had taught and evaluated science courses in general education at the University of Chicago, was invited to join our staff in September, 1951. Immediately he organized a committee of representatives of the science departments to set up an integrated science course for non-science students.

After many months of weekly meetings and much discussion of various types of courses, the block-and-gap type was selected, and certain topics from each major science field were developed in detail. The course is to be experimental for three years, with class sections limited to 24 students –choice of this course or a traditional one is optional– and suitable meth-

ods are to be used to evaluate its worth. The course was started in the fall of 1953, with two sections. A general impression of its nature is given in the catalogue statement, which follows:

132.1, 132.2, 132.3, 132.4 – EXPLORATIONS IN THE SCIENCES I-IV. Each 5 periods (2 lec., 3 lab.); 3 credits.

A study of science and scientific methods achieved by a thorough analysis of selected problems in the physical and life sciences, with emphasis upon the interrelations among the natural sciences and their relations to other branches of knowledge. The problems will be studied through discussions, lecture, demonstration, and individual laboratory work.

Students in the A.B. curriculum who did not choose the Science Group may satisfy their science requirement by taking 132.1 and 132.2 and either 132.3 or 132.4. 132.1 and 132.3 are courses where the integration is developed around physical science problems; 132.2 and 132.4 are courses where the integration is developed around life science problems. It is desirable that college required mathematics be taken prior to, or concurrently with, 132.1.

The objectives of the course, as formulated by the Committee, follow:

The subject matter, methods, and learning materials of "Explorations in the Sciences" should be so chosen that the student will acquire, in addition to a body of scientific knowledge, certain concepts, attitudes, and motivations that will contribute to his growth as an individual and as a member of a democratic society. To this end, the program should aim toward developing in our students the following:

1. An understanding of the nature of science.
2. An understanding of methods used by scientists.
3. An active intellectual curiosity, an openness of mind, a passion for truth, a respect for evidence, and an appreciation of the necessity for free communication in science.
4. An awareness of the fact that the boundaries of the categorized sciences are largely artificial.
5. An appreciation of the unity of purpose in a program of general education.
6. An active concern regarding the application of their knowledge of science and its methods in the solution of some of the problems which face the citizens of a free society.
7. An ability to view science in relation to its own past and to general human history.
8. An effective power of communication in science.
9. An appreciation of the pleasure that can come from an understanding of the beauties and forces of nature.

Topics included in the course are as follows:

Semester I

1. What foundation supports the skyscrapers, bridges, and tunnels of New York City?

2. What is the nature of matter?
3. How is the structure of an organic compound determined?
4. How has the study of motion contributed to man's understanding and conquest of nature?

Semester II

1. How can we account for the apparently inexhaustible supply of the nitrogen needed to fulfill the nutritional needs of plants and animals?
2. What phenomena underlie movement in living things?
3. How does the heart operate as a pump sensitive to the changing needs of the body?

Semester III

1. How does the physicist explain the interaction of matter across space?
2. What is the nature of atomic energy and how may it be used for the welfare of mankind?
3. What is the age of the earth?

Semester IV

1. How have changes in the limbs of mammals helped them to survive in different environments?
2. Why do individuals that are biologically related resemble each other?
3. What is race?

As indicated above, two topics—numbers 1 of the first semester and 3 of the third semester—are geological in nature. For this journal it is appropiate to give some details as to how these topics are developed.

WHAT FOUNDATION SUPPORTS THE SKYSCRAPERS, BRIDGES, AND TUNNELS OF NEW YORK CITY?

(Time: 4 weeks)

Because this topic deals largely with objects that can readily be seen, handled, or walked upon, it is a more appropriate introduction than such an abstract topic as the constitution and structure of the atom.

To answer the main question of the topic, procedure is directed toward developing four subtopics in the form of questions.

I. What can be learned from surface examination?

The first class session consists of a two-hour field trip in Central Park or Bronx Park, to study exposures of the Manhattan schist. Observations are made on the trend of the foliation and cross joints, both in compass direction and in relation to the direction of the streets. Glacial striae, roches moutonnees, and erratic boulders are examined. Specimens of the schist are collected for laboratory study. Appropriate readings are assigned on metamorphic rocks and the minerals that compose them (Pirsson and Knopf, 1947—see references at the end of this section).

In the following laboratory and discussion periods the origin, struc-

tures, and composition of mica schist are discussed in detail.The specimens collected are examined both grossly and minutely. Some are crushed, and the fragments are identified by physical properties. Some of the optical means of identification are observed in prepared thin sections.

The second week starts with a trip from the Harlem River to Grand Concourse along 168th Street. In this short distance the city's three main rock formations–Fordham gneiss, Inwood marble, and Manhattan schist–can be seen, with north-by-east strike and eastward dip. Similarities and differences among the three formations are observed. Specimens of gneiss and marble are collected for laboratory study. Readings are assigned on geological structures and geological field work (Trefethen, 1949).

In the laboratory and discussion periods the new specimens are examined and compared with each other and with the schist. Discussion leads to consideration of the forces that produce folding and metamorphism of rocks. A rough structure section is drawn, and methods of measuring the thickness of a rock formation and calculating its depth are discussed.

The third week starts with a trip to the Palisades. Glacial striae here are measured and compared with those seen in Central Park. The bedrock is examined and identified with some of the erratics seen in Central Park. On the walk down to river level the characteristics of the Palisades rock, especially the tilting of the columnar blocks to the west, are noted. An outcrop of the sediments beneath the diabase is examined, their weak and crumbly nature suggesting a cause for the location of the Hudson River channel. Specimens of the sediments and of the diabase are collected. Reading is assigned in Pirsson and Knopf (1947) on dikes and sills.

II. What are the methods and results of subsurface exploration?

Methods of exploratory drilling are discussed, drill cores and drills are exhibited, and geophysical methods are discussed. Readings are assigned in Trefethen (1949) on methods of drilling and depth to bedrock.

III. How are geological data portrayed?

The areal geology map of the Harlem quadrangle is examined and compared with the topographic map to note the relationships between bedrock and topography. Structure sections across the Hudson, Harlem, and East rivers are examined, and the relation of those channels to the bedrock is noted. From the field observations made by the class a generalized profile and structure section is constructed from Fort Lee, New Jersey, eastward to the Grand Concourse in the Bronx.

IV. What are some of the influences of geological conditions on engineering projects and city growth?

A trip to the top of the Empire State Building or Radio City, with maps

in hand, is appropriate. If for any reason this trip is not feasible much can be accomplished in the laboratory with maps and aerial photographs. The orientation of Manhattan Island is compared with the strike of the foliation observed in the rock formations. Offsets on the east side of the island and transverse depressions are related to faults.

Inasmuch as the deep channels around Manhattan Island necessitate bridges and tunnels, it is well to consider the origin of these channels: (1) The effects of pre-glacial differential weathering and erosion produced valleys on the weak sedimentary beds and the marble, while the more resistant gneiss, schist, and diabase formed the dividing ridges. (2) The southward-moving ice sheets were thicker in the valleys and gouged them still deeper. (3) On melting of the ice the sea level rose, resulting in drowning and silting of the valleys.

Finally there is the matter of the influence of bedrock in selecting sites for bridges, tunnels, and tall buildings. The sites of George Washington and Triborough bridges, Holland and Lincoln tunnels, and Radio City and Empire State buildings are examined on the geologic map. Readings are assigned (Berkey and others, 1933; Creagh, Ed., 1948). *Life* magazine's article on "Underground New York" (November 7, 1949) is also consulted.

Typical review and test questions used in this study follow:

1. Where did the boulders that you saw in Central Park come from?
2. If you were to make a drill hole at 168th Street and Jerome Avenue all the way through the Inwood marble, what rock would you expect to find beneath it?
3. Account for the fact that, in the Bronx, both University Avenue and Grand Concourse are on higher ground than is Jerome Avenue.
4. Why is the main span of George Washington Bridge so long and without supporting piers in the middle of the river?
5. Account for the fact that the Broadway subway is above ground between 122nd and 130th streets.
6. What geological advantages does New York City offer for construction of skyscrapers, as compared with Mexico City? (See *Life* magazine, Nov. 17, 1952.)

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WHAT IS THE AGE OF THE EARTH?

(Time: 5 weeks)

This topic is especially appropiate for it illustrates contributions and interrelations of various sciences in solving a particular problem.

After some discussion of the history of the problem, the principle of uniformitarianism, and the methods of measuring geological time, the topic is developed by means of the following questions:

I. What answer is given by the thickness and mass of the sedimentary rocks that represent the geological periods?

In class and by means of assigned reading in physical and historical geology textbooks, the students are introduced to the main units (periods) of the geological time table and to the principles of transportation and deposition of sediment by water. Methods of gauging, metering, and sampling river water and its sediment content are also discussed.

In the laboratory the students filter a liter or quart of river water and dry and weigh the residue to determine the quantity of mechanical sediment per liter or per gallon of water. Assuming that the sample examined is an average one and assuming also, if it is not known from recorded measurements, a certain annual discharge of the river, the students calculate the quantity of sediment annually donated by that river to the sea. If the drainage area of the river is known, the quantity of sediment contributed by each square mile can be figured. This experience gives the students some conception of the immensity of the task of accurately measuring the total quantity of sediment annually carried from land to sea.

Then comes the task of estimating the total bulk, or mass, of preserved sedimentary rocks—or, more accurately, of looking up the estimates made by others. It is then a matter of simple division to determine the time required to accumulate that mass of sediment.

Calculations may be based also on the total thicknesses of the various kinds of sedimentary rocks and the rates at which these sediments accumulate. Although measurements of these rates vary widely, Schuchert's figures (1931) may be accepted as an average. Also his estimates of total thicknesses of sandstones, shales, and limestones may be taken as a basis for the calculation of time.

After the above calculations have been made there still remains the problem of corrections for such errors and omissions as follows: (1) Much of the sediment is cyclic—that is, deposited, eroded, and redeposited. (2) The present rate of erosion and deposition is believed to be faster than average, because of higher than average stand of continents, much loose glacial debris, and man's activities. (3) Some sediments are inaccessible,

and others are too badly deformed to be measured accurately. Each of these corrections will add to the length of time.

II. What is the age of the ocean, based on salinity?

As in the case of clastic sediments, the average salt content of the waters of many rivers has been measured and the annual increment to the ocean calculated. Also the total salt content of the present ocean has been roughly determined. Assuming a more or less salt-free primeval ocean and a uniform rate of transportation in the past, the length of time needed to produce the present salinity of the ocean is easily calculated.

Here, too, upward calculations must be made. Some of the ocean's salt has been precipitated from time to time, forming the beds of rock salt that now occur in various parts of the world. And some of the salt now carried by rivers is cyclic.

As a laboratory exercise the students evaporate 100 grams of water from the open ocean and weigh the residue. The instructor then runs a quantitative analysis for sodium or chlorine.

III. What is the evidence from biology and paleontology?

Typical fossil assemblages of the Paleozoic, Mesozoic, and Cenozoic demonstrate the general progress of evolution at a slow and non-uniform rate. Specific stages in the evolution of the horse, from *Eohippus* of the Eocene to *Equus* of the Pleistocene, are discussed and illustrated.

Although no specific number of years can be derived, the evidence of organic evolution seems to require and to allow for a long period of time.

IV. What are the data from astronomy?

Discussion covers such topics as rotation and tidal friction; the age of the sun's heat; the alleged cooling of the earth; the fallacy in Kelvin's calculations, since radioactivity was not yet known. Again specific figures are wanting; but the evidence allows for a long period of time.

V. How does radioactivity help solve the problem?

Class discussion begins with a review of nuclear reactions and a study of the half-life periods of the uranium family; the method of determining radioactive constants; and the equation for finding the half life of a radioelement. Measurement of time by the helium and lead methods is explained. Some radiocarbon dates are examined to show how closely these computations coincide with recorded historical dates.

Laboratory work consists of an examination of sample structure sections which show the relative ages of intrusive, intruded, and extrusive rocks. The behavior of the Geiger counter is demonstrated in the presence of radioactive minerals. If a suitable short-period radioisotope can be ob-

tained, its half life will be measured and plotted. Finally, there is a visit to the Lamont Geological Observatory at Palisades, New York, to observe equipment and procedures in the Radioactive Minerals Laboratory.

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EVALUATION

At present, after two semesters of the course, evaluation is carried on by the instructor and by the students themselves. The instructor keeps a log of class activities. He also gives pre-tests and post-tests on each unit to determine the degree of student growth. Throughout the semester the students are encouraged to give oral criticisms; and at the end of the term each one is asked to submit his evaluation in writing. With the aid of the Director of Research and Evaluation of Hunter's Division of Teacher Education a more comprehensive scheme of evaluation is being arranged.

As stated above, this course is experimental and revisions are in order. Even at this writing certain changes are in process. The original requirement of three semesters, three credits each, is now reduced to two semesters of four credits each. Certain of the topics originally assigned to semesters III and IV are to be added to semesters I and II, and the others will be kept in a stock pile for possible alternate use.

As indicated by the increasing enrollment, the course is growing in popularity. In addition to whatever benefits the students may derive from the course, the members of the staff who have contributed to the development of this project, under the able leadership of Professor Raskin, have gained in better understanding of each other's special fields, in greater cooperation with each other, and in more cordial friendships.

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A PERIODIC TABLE OF ELEMENTS FOR GEOLOGISTS*

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The purpose of the accompanying table (Pl. 1) is to increase the usefulness of the periodic system and the concept of atomic size in geologic instruction. The table is designed mainly for mineralogy, but it would also be helpful in such fields as petrology and economic geology. It is unfortunate that the geology student usually hears little of the periodic table after completing his chemistry courses. The table is not even included in some of the common mineralogy texts; yet it is nearly as useful in mineralogy as in chemistry. An earnest effort should be made to aid the student in carrying over to geology the relationships based on the periodic system which he has learned in chemistry. Deductions based on the periodic system and sizes of atoms will enable the student to cut down on his memory work. The material then not only becomes more interesting but is likely to be retained much longer.

The fact that many physical and chemical properties can be deduced from the position of an element in the periodic table is well known. Also since the geochemical nature of an element is mainly controlled by its atomic structure, this characteristic is related to the position of the element in the periodic table. The elements which form ions with 8 electrons in the outer shell tend to form silicates. Most of these are on the left side of the periodic table. On the other hand the elements whose ions have 18 electrons in their outer shells, such as copper, zinc, and lead, have an affinity for sulphur. These are found just to the right of the center of the periodic table. The ionic potential of the elements can easily be calculated from data given in the table. Ionic potential is important in determining the distribution of elements in organisms and the behavior of elements during sedimentary processes (Mason, 1952, p. 139 and p. 198).

Additional properties of minerals can be explained when the sizes of atoms making up the crystal are taken into account. The student should realize at the outset that atoms are not solid spheres and that the radius of an atom refers to the radius of its sphere of influence or sphere of neg-

* This paper was presented on April 4, 1953, at the third annual meeting of the Eastern Section and the first annual meeting of the New England Section (joint session) of the Association of Geology Teachers, at Rensselaer Polytechnic Institute, Troy, New York.

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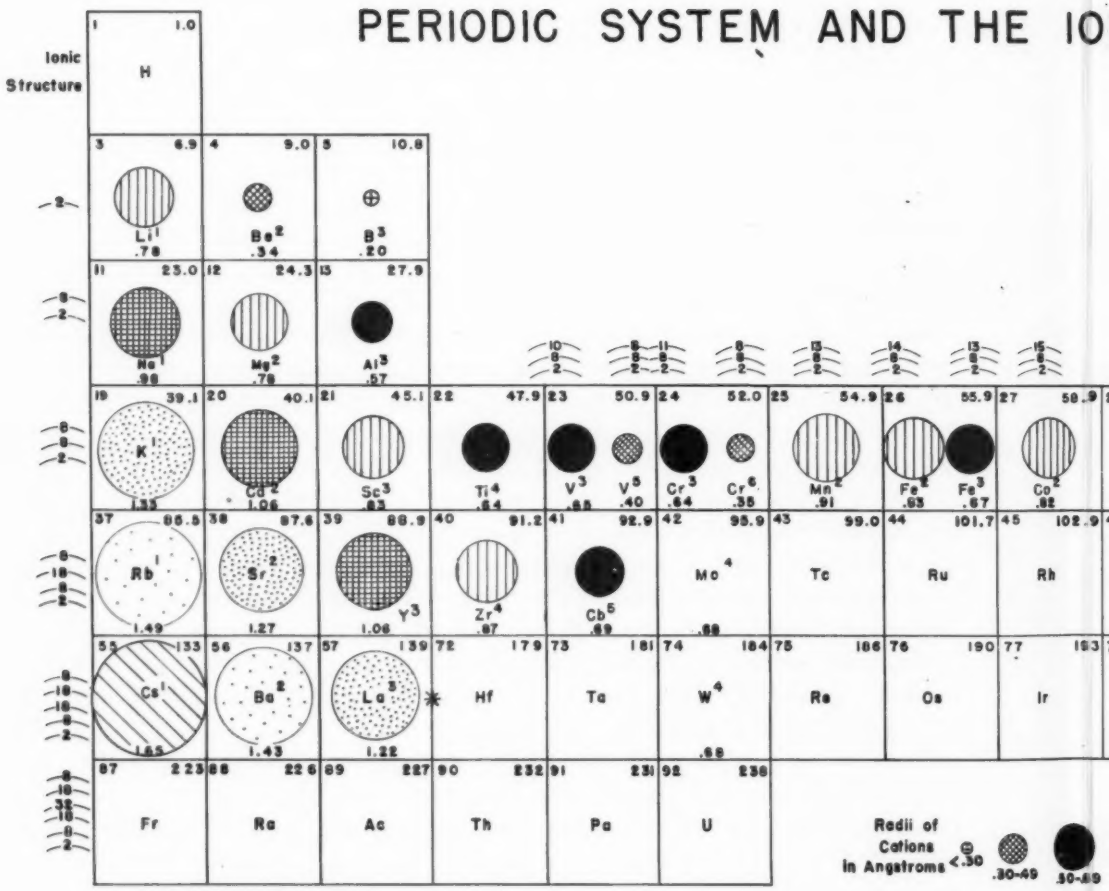
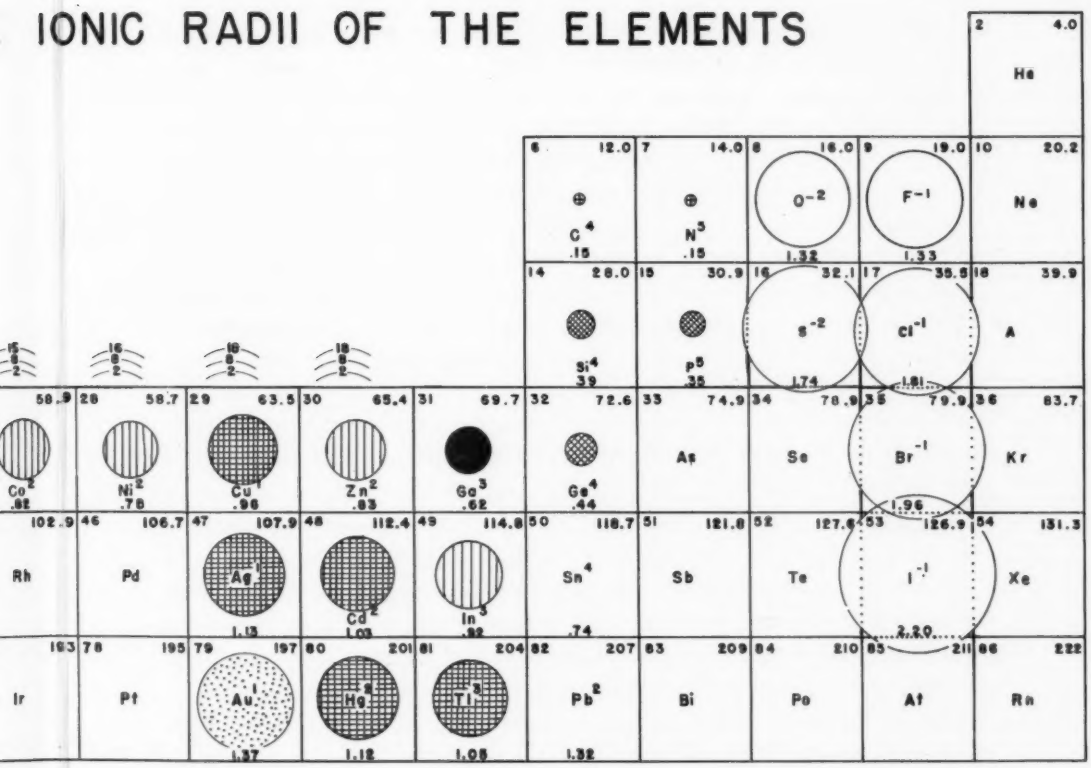


* 58-71 Rare Earths

Data from Geochemistry by Rankama and Sahama

IONIC RADII OF THE ELEMENTS



Ionic radius for 6-fold coordination and the valence states indicated.

M.T. Heald E.J.M.

Journal of Geological Education, Vol. 2, No. 1, Pl. 1

ative electricity. The sizes of atoms or ions may be given in several ways. Commonly they are simply tabulated alphabetically or according to atomic number. Another method is by means of a graph in which the radius is plotted against the valence. However, for instructional purposes the scheme of giving sizes on a periodic table is much more useful. If the atoms or ions are plotted to scale, comparisons can readily be made. Where the sizes are given on a periodic table, the student can easily see the relationship between size and electronic structure. Thus, in the accompanying table, it is apparent that there is a general increase in size from top to bottom in a given vertical column. This, of course, is due to the increase in the number of electron shells. These shells are shown schematically along the left edge of the table. The decrease in size due to a net increase in positive charge is shown along rows starting at the left-hand side of the table. The increase in nuclear charge tends to compensate for the increase in number of shells in such a way that the ions along a diagonal on the left side of the table have about the same size. Thus the ions of the elements lithium, magnesium, scandium, and zirconium have nearly the same radius. The similarity in the ionic sizes of the elements near the centers of the rows is due largely to the fact that for each increase in nuclear charge an electron is added to one of the outer shells. This is shown by divalent manganese, iron, cobalt, and nickel. The electron configuration of these ions is also given in the table. The large increase in size due to the addition of electrons in the valence shell is strikingly shown by the anions on the right side of the table.

Ions of the same order of size are set off from ions of different size by the use of different patterns. At a glance, then, it is possible to see which ions are approximately of the same size. Thus the ions shown with the same pattern tend to be mutually replaceable in isomorphous minerals provided, of course, that electrical neutrality is maintained. Ions in a given size group are likely to substitute for ions in the next size group to a limited extent. However, where size differences are greater than this, substitution is improbable.

The sizes of only the more significant ions are shown on the table. In addition to the ions which commonly occur in minerals, some ions are included which aid the student in seeing the relationship between size and ionic structure and show the pattern of size variation. In order to keep the chart as simple as possible, no atomic sizes are shown. Actually the atoms vary in size in about the same way as do the ions.

Henderson (1951) pointed out the usefulness of the relation between ionic size and crystal structure. This approach should be given more ser-

ious consideration in the teaching of any of those phases of geology dealing with minerals.

The size concept can be extended to explain many of the variations in properties of minerals. In minerals with similar structure, hardness varies inversely with the sizes of the constituent ions and directly as the valence (Stillwell, 1938). Thus calcite is the softest of the rhombohedral carbonates because it contains the largest cation. In the spinel group magnetite with larger ions (ferrous and ferric iron) is softer than spinel with smaller ions (magnesium and aluminum). In general, minerals with aluminum in the sixfold positions—such as corundum, jadeite, and spodumene—are harder than corresponding minerals with larger cations (magnesium, iron, manganese, etc.) in the sixfold positions. Variations in specific gravity are related to differences in atomic weights and atomic or ionic sizes in minerals with similar structures. In isostructural minerals with ions of the same size the specific gravities vary in the same ratio as the molecular weights. For example, the specific gravity of cerussite is about four fifths greater than that of strontianite because cerussite has a molecular weight about four fifths greater and has ions of approximately the same size as those in strontianite. However, a variation in the size of ions may more than offset the effects of increased molecular weight. Thus the specific gravity of sylvite is less than that of halite even though its molecular weight is appreciably greater. Although calculations of exact variations in specific gravity are often rather involved, the student can easily ascertain the correct order of magnitude of the relative specific gravities of many minerals if he has a knowledge of the approximate sizes and weights of the ions involved.

Many other examples could be cited to illustrate the value of the concept of ionic size. However, it is of little use to the student who does not have a systematic method of remembering the variations in size. The proposed table largely solves this problem and aids the student in retaining those relationships he learned in chemistry.

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WATER CONSERVATION AS A COURSE FOR THE GEOLOGY DEPARTMENT*

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The increase in national concern over the conservation of our natural resources has been so rapid in recent years that college curricula have in general failed to make the changes needed to educate students in new materials germane to the subject. Many geology departments offer some sort of work dealing with ground water, but few give a complete treatment of all aspects of water conservation problems. Other departments may be concerned, in passing, with health or engineering aspects of water, but such treatment as is offered is ordinarily so widely diffused in various departments or schools of an institution as to offer little help to the student approaching the matter from the angle of conservation.

SCOPE OF THE COURSE

The course suggested below is the result of the writer's experience in two conservation courses, one at the introductory level and one at the senior-graduate level.

Surface Water

The best approach to this phase of the study seems to be through use of a local stream as an example, and, to some extent, as a laboratory. With luck it will be possible to find a near-by stream with a drainage area of 50-200 square miles, on which the U. S. Geological Survey maintains a gaging station. The students can briefly examine the watershed in the field, in order to estimate ground cover, slope conditions, land use, etc., as a preliminary to measuring on maps the watershed area and to studying data on climate and weather.

If a gaging station is in operation on the stream it may be possible to obtain frequent readings on stream flow, and to correlate these with simple precipitation and soil moisture readings taken within the watershed. From these a flow regimen for the stream may be derived. Lacking a regular gaging station, a simple staff gage will provide significant information.

* This paper was presented on April 3, 1953, at the third annual meeting of the Eastern Section and the first annual meeting of the New England Section (joint session) of the Association of Geology Teachers, at Rensselaer Polytechnic Institute, Troy, New York.

Once these basic figures are at hand, the conservation aspects of the problem can be examined. A series of questions will suggest possible approaches.

1. Does the stream have a bad flood record? Has it caused flood damage in the form of building and highway destruction, bank erosion, deposition on farm lands or in reservoirs? If so, what is the best economically feasible flood prevention plan for this particular watershed?

2. Is the stream a source of water for industrial or domestic use? If so, what are the present and probable future demands for such water? Can the stream supply all these demands at all seasons? What measures can be taken to improve the supply?

3. Does the stream provide the recreational facilities needed in the area? Can this situation be improved?

4. Is the stream polluted by industrial or sewage wastes?

5. Is the stream capable of being improved for power development?

6. Should potentialities for irrigation be considered?

7. If suggestions are made for improvements in items 1–6 above, how can they best be combined into a unified plan?

8. If such a plan were to be carried out, how should it be financed?

It is immediately apparent that the teacher of such a course should be a geologist-pedologist-hydrologist-biologist-engineer-meteorologist-lawyer, who is likely to be found only on the faculty of Utopia University. It is the writer's belief that outside that happy institution (where instructors begin at $8,000) the necessary breadth of information and outlook can be found only in the geology departments.

Once the students have completed this relatively detailed survey of a local stream which they can examine personally, the instructor will of course choose a few examples of other watersheds having different characteristics, different problems, and therefore different solutions to those problems. These may well be handled in lecture-plus-seminar style.

Ground Water

Less comment is needed here, as this phase of the study is more familiar to and more thoroughly treated by the average geology department at present. Additional emphasis should be placed on:

1. Over-pumping, its determination and elimination.
2. Recharge methods.
3. Ground-water pollution.

OPERATION OF THE COURSE

Since it is neither feasible nor desirable in most colleges to add a

new member to the department staff for a course of this type, it would be conducted by someone already on the faculty. The load of "working up" and conducting a course in somewhat unfamiliar material can be considerably lightened if the teacher takes advantage of all the agencies that can be drawn upon for helpful cooperation. This help may range from advice, data, maps and publications, to actual participation by visiting lecturers on special fields. As an example, the writer receives continuing help in conduct of such work from: U. S. Geological Survey, U. S. Soil Conservation Service, Dutchess County Water Conservation Committee, Agricultural Extension Service, Civil Aeronautics Authority, Dutchess County Sheriff's Office, and private individuals.

PUBLIC SERVICE VALUE OF THE COURSE

For obvious reasons, in matters of "college--community cooperation" geology teachers sometimes fall behind their colleagues in other fields. A course of this type presents an exceptional opportunity for such cooperation. If the students are to prepare a plan for the conservation treatment of a local watershed, this plan, polished by the efforts of several classes, may be offered to the community as a focus for their discussion and action. Many drainage basins now have watershed associations planning for improvement and conservation of water resources, so that if one of these already exists the tie will be a natural one. If it does not exist, the plans coming out of the course can be used to start such an association.

In areas where floods are frequent, on-the-spot and up-to-the-minute knowledge of local conditions makes it possible to prepare more specific and detailed forecasts of flood times and heights than can be achieved by the regional Weather Bureau office. This may well be a local service of real importance.

ITS VALUE FOR THE TEACHER

The exploration of a new field of expanding importance is a considerable reward in itself. Development of a new, forward-looking (and not too expensive) course in such a field is likely to be well regarded by administrative officers.

The increase in water problems has resulted in a rise in the number of requests for advice on a consulting basis. Some water problems are essentially engineering matters, and should properly be handled by professional engineers. Many of the questions that arise, however, are geological in nature, and can best be referred to a geologist with some experience in such matters. The writer suggests that until the day arrives when

the reader's institution is able to match the pay scale offered by Utopia University, teaching geologists might well augment their incomes by doing a greater amount of consulting work on water problems.

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THE GEOLOGY TEACHING CRISIS *

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Since 1950 it has been evident that an acute shortage of geologists would soon occur in this country. It is here now! As Levorsen (1952) has shown, the number of undergraduate majors in geology slumped 39 per cent from 1950 to 1952. Apparently the trend has not yet ceased.

Immediate results are the highest salaries in the history of our profession, with the largest increases occurring, of course, in private industry. Salaries of geology teachers have risen too, but usually not even enough to offset the past decade's rise in cost of living. Competition for young graduates–between industry, government, graduate schools, and the draft–is becoming ruinous. Untrained A.B.'s are now being hired by oil companies at salaries higher than those paid to Ph.D. instructors of geology. In fact, many colleges have eliminated the rank of instructor and start green Ph.D.'s with the title of assistant professor, hoping that the more august rank will somehow compensate for a too modest salary.

The secondary results, already apparent, may injure the profession seriously unless alleviated. Penalties for teaching geology, already too high, are rising rapidly as demand for trained geologists increases and the supply dwindles. Teachers of all ranks are fleeing campuses to work for oil companies or for the government, in the U. S. Geological Survey, the Atomic Energy Commission, etc. Untold others are on the brink of leaving. Two past-presidents of the Geological Society of America, college professors of the highest prestige, recently joined the flight. The teaching profession has long been used to turnover in the lower ranks, but this is something new and ominous. If drastic measures are not taken to keep geology teachers teaching and to attract the best new brains to that calling, the entire geology profession may suffer irreparable damage.

As President E. S. Burdell (1953) of The Cooper Union has put it:

> Security and human dignity, once the chief protectors of the low pay scale of the teaching profession, are finding their places in industrial personnel policies and practices as fast as ways can be found to provide them to workers.

*This paper was presented on April 3, 1953, at the third annual meeting of the Eastern Section and the first annual meeting of the New England Section (joint session) of the Association of Geology Teachers, at Rensselaer Polytechnic Institute, Troy, New York.

Viewed selfishly, education is losing an important advantage in the essential business of attracting especially talented teachers and holding them in the face of industry's addition of these basic factors to its higher wage levels.

I agree with all Burdell says except his idea that his is a selfish view. Basic unselfish questions are: (1) In view of diminishing supply and booming demand for trained geologists, are experienced college teachers essential? (2) If so, how are we to protect the geese that lay our golden eggs? In short, how can we keep geology teachers teaching and attract new teachers with the highest qualifications? *Only*, I submit, by a concerted recognition of and drive to alleviate a crisis in the geology profession. Its teaching members cannot indefinitely penalize themselves and their families by stubborn dedication to genteel stultification.

In addition to course teaching, basic geologic research is also at stake. Ira H. Cram (1952), of the Continental Oil Company, told the Pacific Section of the American Association of Petroleum Geologists:

It is no secret that technology depends upon research—both fundamental and industrial. Unless research is pushed vigorously, advances in technology will slow down to a walk. The calamitous consequences of such an event need not be mentioned. Adequate research requires constant pushing, constant encouragement, a lot of money—and it also requires adequately trained manpower. The training of enough properly trained research men and women is an educational problem of gigantic proportions aggravated by well-known governmental policies on manpower for the military.

Webster's dictionary defines *crisis* (non-medically) as "the point of time when it is decided whether any affair or course of action must go on, or be modified or terminate; also, a state of things in which a decisive change one way or the other is impending." The Association of Geology Teachers should be the best judge as to the appropriateness of my title. I urge a concerted attack upon four fronts, namely: college and university administrations; civil government agencies; the Defense Department; and private industries, primarily the major oil companies.

1. **College and university administrations** must awake to the realization that salaries and other emoluments paid geology teachers must bear some relation to the laws of economics; that competition from government and industry makes rigid horizontal salary strata for a given rank unrealistic; that geologists and engineers, for example, are worth more, in the language of the market place, than their colleagues in fields lacking commercial pressures. Failure to recognize this will increase the tendency for able teachers to leave the campuses, crippling geological education.

2. **Civil government agencies**, such as the U. S. Geological Survey, should liberalize their employment policies to enable many more teachers

to do research on a temporary basis, either by the month or sporadically, perhaps as consultants. Civil service regulations should be modified as necessary, or by-passed, in order to enlist the know-how of professors able and eager to contribute part-time services.

3. **The Defense Department** should alter the draft policies so as to maintain or preferably to increase a continuing flow of highly trained professional geologists. It makes little sense to defer huge masses of undergraduates and at the same time to decimate the relatively tiny but vital ranks of Ph.D. candidates or the staff of our own U. S. Geological Survey! Our Defense Department policy makers may well emulate the Canadians, whose manpower problems are at least as severe as ours. In World War II not only did the Canadian government not draft geologists, but it sternly refused, with a few exceptions, to permit them to enlist or to apply for commissions in the Canadian armed forces.

4. **Private industries, especially the major oil companies,** as employers of two thirds of all geologists, have the largest stake and therefore the major responsibility in this crisis. They might well support geology teachers by such devices as:

(a) Liberal research grants, including travel allowances. Industries already support graduate student fellowships, with no strings attached. Teachers need no less support!

(b) Retaining fees paid to teachers for serving as advisors, in the broadest sense of the word.

(c) Expense allowances for sending college teachers as "company delegates" to conventions and congresses, where they will serve as personnel officers. Personal recommendations are still given great weight by employers. Present unofficial corridor conferences with counsellors of prospective employees could perhaps be made official in this way. This could well complement the long circuits made by personnel officers to the larger colleges each year for interviews.

(d) Expense allowances for educational writings—text and reference books, for example.

(e) Expense allowances to support travels during sabbatical leaves.

Others may occur to the companies most concerned, but measures such as those suggested would be enormous morale builders and would materially aid in keeping geology teachers teaching.

Fifteen years ago Lahee (1938) raised the question, "Where shall our young graduates in petroleum geology acquire field experience?" In reply I took the liberty of suggesting three methods (Lucke, 1939). It is interesting to see that two of them—planned apprenticeships and subsidized independent field work—are now common if not standard practice.

The geology teaching crisis should command far more attention than

that minor ailment of the thirties. Whatever measures are taken, they cannot wait another fifteen years or even five years. The time is NOW.

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* *

"WHOSE GOLDEN EGG?"

May the president of a "small college" unburden himself to the president of a "big business," for a moment, on a matter of vital concern to college, business, and the nation as well?

I am releasing to your company a professor of geology... Your company has prevailed on him to assume a very responsible position and certainly I would not stand in the way of his advancement... Your salary was five times what we paid him...

Our college is "small" as enrollments go... and in budget... But in scholastic standing it holds its own with the best in the land. For years it has sent a stream of geologists to graduate schools and to responsible positions in government and industry.

The scores of geologists we have provided for the petroleum industry have cost your company little or nothing to train. We have discovered these students, trained them, and sent them to you ... We have been happy to do this, though the faculty members who have taught them have salaries—after many years of teaching—a good deal less than some of these receive at the outset of their careers. And the differential becomes so great as they advance that we find it almost impossible to secure new teachers.

I am concerned about the small college. You are concerned about private industry. Is there not a partnership here that should be recognized? I shall release our professor to you—reluctantly, for it will be harder for us now to provide you with more young geologists... We will still hope that "big business" will see its dependence on institutions that to some may seem relatively "small," but essentially are institutions that help determine the future of America.

(The unsigned letter from which the above excerpts are reprinted was originally published by the Association for Higher Education in *College and University Bulletin*, Vol.6, No. 2, October 15, 1953.)

JOURNAL OF GEOLOGICAL EDUCATION
Vol. 2, No. 1, Spring 1954

"THE FACE OF THE LAND"—A REVIEW*

Henry S. Sharp
Barnard College

"The Face of the Land," the third part of *Life* magazine's authoritative series, "The World We Live In," is well written, beautifully illustrated, and generally accurate. It demonstrates that a successful job of scientific exposition may be done with little use of technical terms.

As its title indicates, this article purports to explain the origin of the land surface of the earth. Careful reading, however, suggests that the title is broader than the coverage, and that the article might more appropriately have been called "The Face of the Mountains," for it is concerned almost entirely with the development of scenery in mountains of volcanic, fault block, and fold origin. True, some reference is made to residual mountains, such as the Catskills and the mesas and buttes of the Grand Canyon, where deep erosion in uplifted regions of simple horizontal sedimentary rock has produced mountainous relief. Hardly mentioned, however, are the tremendous areas of low and monotonous relief, underlain mainly by essentially horizontal sedimentary rocks. In the United States such regions would include the great Atlantic and Gulf Coastal Plains, the latter extending up the Mississippi River to southern Illinois; the Great Plains; and much of the Colorado Plateau. The scenery in such regions is usually less interesting and spectacular than that in areas of more complex geology; but the total area of such regions of horizontal structure, not to be called mountains under any customary terminology, probably exceeds by far that of all the mountainous regions of the United States.

Many readers of *Life* will be moved to classify the mountains known to them as of volcanic, fault, or fold origin. Unfortunately, this may not always be easy, for Nature was unaware of the classification of mountains when she made them. Often she seems to have mixed her recipes in a manner most confusing to the mind of man. For instance, how shall the mountains of New England, of the Piedmont, or of the Blue Ridge be classified? In the classification as given we shall not find the proper category, for such mountains as those of New England cannot be simply classified.

* "The World We Live In: Part III, The Face of the Land," with text by Lincoln Barnett, appeared in *Life* magazine, April 13, 1953. This review was prepared for use on the TV show, "Omnibus," a presentation of the Ford Foundation's TV-Radio Workshop, on April 12, 1953.

They have been folded and faulted, lava has poured over them, and molten rock has penetrated their interiors; and these things have happened not once but many times. So for such mountains, students of the face of the earth have had to invent a fourth category, mountains of complex structure.

Again and again, perhaps without making their relationship quite evident, the article refers to the three factors most potent in shaping the face of the land. The first is structure, and the illustrations make it very clear that regions of folded structure have different topography from faulted regions. The second major factor determining the appearance of the land is the type of erosion, whether by streams, by wind, by glaciers, or by waves, or by a combination of these agents. A region of folds eroded by streams would appear quite different from one heavily glaciated. So far as "The Face of the Land" attempts to be a rounded explanation of the origin of the surface of the land, it is unfortunate that at least passing reference was not made to the ever-pounding hammer of the waves. Here is a fourth agent capable, like those that were discussed, of reducing the proudest continent to a plain of erosion near sea level. It is only fair to mention, however, that the work of waves was fully discussed in the second article of the series, "Miracle of the Sea."

Finally, the third factor in shaping the face of the land is the stage of erosion. This is spoken of as youthful, mature, or old, depending upon the amount of erosion the landmass has undergone, and the terms have no necessary reference to the actual age of the mass in years. Thus two regions of folded mountains, each eroded by streams, would differ greatly in appearance depending upon the stage of their erosion.

In contrast to the West, New England is commonly called an old region geologically, but this is true only in certain respects. The title of the beautiful view of the Saco River with Mount Washington on the skyline speaks of an "old landscape" and says that the upheaval which produced Mount Washington occurred 280 million years ago. This statement gives a misleading picture not only of New England but of the entire eastern United States. It is true that the bedrock of the East is generally older than that of the Far West, and that the great internal mountain-making movements that folded and faulted the rocks of the two regions often took place more recently in the West. But in the western United States it is often true, as it is always true in the eastern United States, that the original mountains have been worn down to low plains, and their present elevations are due largely to later vertical uplifts affecting entire regions. Thus it is not strictly correct to say that Mount Washington is 280 million years old. The rocks of the mountain may be that old or older, but much of its present ele-

vation is due to vertical uplift, which affected all of New England and took place only a few million years ago. So, according to a better interpretation, New England is not an old region. After the great internal forces of the earth gave it its complex structure hundreds of millions of years ago, it was worn down to an almost featureless plain with here and there a rounded, residual mountain. At that time it was old. Since then, the featureless plain has been vertically uplifted to a maximum of a couple of thousand feet, and streams have just begun to erode it once more. It has been rejuvenated and is in its second youth, and it will be millions of years before it is so worn down again that the scenery may properly be called old.

In the article being reviewed, the rivers of the Northeast in contrast to those of the West are called antique, and it does sound appropriate that a region of antique shops should have antique rivers. But the terminology is generally incorrect. Relatively few of the rivers of the Northeast are to be called old. Most of them still have the characteristics of youth—steep gradients, swift currents, waterfalls, and rapids. If this were not so, New England would not have had its early manufacturing. The gorge of the Deerfield River, the Ausable Chasm, and many other rivers have as many of the characteristics of youth as any river in the West. If they are not so deep or impressive, it is because the land has not been uplifted enough to allow them to cut as deeply, and the heavy forest cover has given them more rounded contours. More by far than the article has indicated, the contrasts between eastern and western topography are due to differences in the cover of protective vegetation.

The greater majesty of the mountains of the western United States results mostly from their higher elevations, which placed them in a zone of lower temperature and greater snowfall, capable of supporting large glaciers. From heavy glacial erosion resulted the magnificent matterhorn peaks, the cirques, the knife-edge ridges or aretes, the U-shaped valleys, and the lakes which so entrance the visitor to Glacier, Rocky Mountain, and Yosemite national parks in the United States and to the magnificent parks in the Canadian Rockies. By comparison, the East has no such scenery. Its lower, smaller mountains could not support such glaciers. But it is not true, as the article states, that there is no topography due to mountain glaciation in the northeast. The illustration of Crawford Notch shows as fine a U-shaped valley as could be found anywhere. The skier in Tuckerman Ravine or the camper in the Great Basin of Mt. Katahdin may derive additional satisfaction from his knowledge that he is in a cirque formed by glacial erosion. The climber on the Knife Edge of Katahdin in a cross wind will find it a sufficiently satisfying arête.

Generally speaking, the earth's crust is now more active geologically in the western part of the United States, particularly along the Pacific Coast, than in the East. Especially is this true with reference to the great tensional and compressional forces that cause movements along faults with resultant earthquakes. And the East has had no recent vulcanism. But we find evidence that the East, if relatively quiescent now, as the article suggests, must have undergone considerable vertical movement not long ago. In northern New York, on the northern edge of the Adirondacks, beaches marking old shorelines of a greatly expanded Gulf of St. Lawrence are found at 700 feet above sea level. These shorelines were formed after the withdrawal of the continental ice sheet, which may have occurred no longer than 20,000 years ago. If so, a regional uplift averaging three and a half feet per century is indicated, a respectable rate of speed in any geological company, and one which does not suffer greatly by comparison with those cited in California. Still, such rapid uplift, though recent, has probably ceased in the northeast, and only an occasional mild earthquake suggests that the earth's surface is not entirely quiet.

The Northeast is far from being as simple a region geologically as many assume. The geological history of the New York City region is especially complicated, so it may not be particularly suited for illustration by a series of step-by-step diagrams. In the series shown, many steps have been omitted and others are subject to difference of interpretation, so that the average *Life* reader may find as many problems raised by these diagrams as are solved. A series illustrating the geologic history of the Colorado Front Range in relationship to the Great Plains might have been more clear and instructive for most readers.

In conclusion the reviewer must note that his criticisms are generally on minor points in view of the over-all excellence of the article. It should easily accomplish its purpose and make evident to its readers that:

> The hills are shadows, and they flow
> From form to form, and nothing stands;
> They melt like mist, the solid lands,
> Like clouds they shape themselves and go.[1]

1. From section cxxiii of "In Memoriam A.H.H.," by Alfred, Lord Tennyson.

BOOK REVIEWS

Map Interpretation. G. H. Dury, with a contribution by H. C. Brookfield. xi and 203 pp. Sir Isaac Pitman & Sons, Ltd., London (British Book Centre, New York), 1952. $3.25 .

Geologists will find this concise volume a stimulating addition to their reference libraries on geomorphology. Although it was written primarily for British readers and based largely upon European maps,the book presents a number of new ideas and unusual areas for use in American colleges, inasmuch as the new maps cited are available through dealers.

Specific geomorphic analyses are given for the student who already has an elementary knowledge of map reading. The material might well be used in the last few weeks of a physical geology course or in a geomorphology course. Rather than trying to duplicate the function of a textbook in geomorphology, the author includes only a brief summary on the subject of landform genesis, along with a useful table to serve as a guide in the analysis of terrain. There are notes on a recently proposed nomenclature for geomorphic subdivisions—a system which deserves careful consideration by American geologists. Included are sketch-map symbols to be used in the selection and simplification of data from contour maps.

Chapters of specific interest to the geologist deal with map examples of scarpland topography, eroded folds, unglaciated uplands, glaciated highlands, limestone country, shorelines, arid landscape, and complex landscape-structure relationships. Several chapters on the features of human occupance, including one on prehistoric occupance, provide material in the field of human geography. One chapter is devoted to an up-to-date review of techniques in morphometric analysis. A chapter by H. C. Brookfield entitled "Cartographic Appreciation" comprises a study of craftsmanship and effectiveness as illustrated in maps of several nations, including those of the United States.

The principal value of this work, besides its wealth of significant geomorphic concepts, is that it provides a unique series of laboratory exercises not bounded by Boothbay, Maine, on the east and Point Reyes, California, on the west.

WILLIAM C. PETERS

Idaho State College

The Principles of Historical Geology. J. Willis Stovall and Howard E. Brown. 472 pp. Ginn and Company, New York, 1954. $6.00

The authors of this textbook for undergraduates have made a sincere attempt to emphasize principles and to introduce new and interesting material. Of the 472 pages, some 140 are devoted to principles, the rest to chronological history. In general the text is well-written, with short, clear sentences. There are many well-chosen and well-reproduced photographs to show geologic structures and their relation to topography. Most of the sections and block diagrams are effect-

ive in illustrating principles or history. The front end-sheets are decorative and helpful geomorphic maps of world landforms by Erwin Raisz; the back end-sheets show a useful chart of organic evolution by Edward Schmitz. Mr. Schmitz has done a good job on the stratigraphic columns and cross-sectional diagrams. Probably the greatest innovation is the series of excellent paleomorphologic maps, one for each period starting with the Cambrian, and twelve structure sections, with geomorphology, by Erwin Raisz. These sections and a North American location map compose Appendix A, Geologic Structures of North America. Seventeen excellent original plates showing ancient life have been prepared by Thomas. W. Voter.

The book starts with six suggestions to students which should help them emphasize the significant principles and relationships of historical geology. The discussion of cosmic geology is up-to-date and should make the student aware of the need for keeping an open mind. There is thorough treatment of the development of the geologic time scale, of the ideas about life on the Earth, and of the significance of fossils.

An early chapter deals with plants and animals and is illustrated chiefly with pictures of recent forms. Appendix B gives the main features of all phyla. Some of the most important fossil groups, such as foraminifera, graptolites, bryozoa, brachiopods, and most molluscs, are not illustrated in either chapter. The reviewer believes that a textbook of historical geology should be self-sufficient enough in its paleontology to present pictures of important forms and their structures, in addition to those shown for the different periods.

The study of paleogeography and methods of correlation is well-handled and illustrated with diagrams and photographs.

Beginning with the Archeozoic, each chapter starts with a simplified statement of distribution and history which should be helpful to the student before he gets into the more detailed discussion. There is an outcrop distribution map of North America, and the stratigraphic development of the era or period is clearly portrayed. References and collateral readings terminate the chapters.

The reviewer feels that this book is weakened by numerous errors of omission and commission, especially in the handling of the paleontology. It seems inconsistent to show plates of fossil invertebrates for the Cambrian, Ordovician, and Silurian, and none for the Devonian, Mississippian, Pennsylvanian, and Permian.

The treatment of the Cambrian would be improved by the addition of pictures of Pleospongiae, brachiopods, gastropods, and graptolites.

The plate of Ordovician fossils is a good example of the need for better organization of material. One set of views of *Platystrophia* practically duplicates the other except for size. *Calymene* is too small to be typical and fails to show the distinctive structures of the cephalon. The very important graptolites are not shown here or elsewhere, although their significance as guide fossils is mentioned in the text. A figure of *Columnaria* is labelled as *Streptelasma.*

In the Silurian chapter, the upper diagram on page 206 makes it appear that at the present site of Niagara Falls the water is flowing over shale stratigraphically higher than the Lockport dolomite. In discussing the first appearance of cephalopods with more complicated sutures, the term "ammonite" is used instead of the better general term "ammonoid." Nowhere are there figures showing the goniatitic and ceratitic types of sutures. One specimen with rather obscure ammonitic su-

tures is shown in the Permian chapter. Some mention should be made of the first appearance of a group so important as the spiriferoid brachiopods.

The Triassic chapter includes several errors. Muschelkalk is spelled Muschkaln on the stratigraphic column. Normal faults of the Connecticut Valley dip westward; those of New Jersey dip eastward. The authors have this reversed. A cross-section (page 305) should show the Palisades dolerite bending sharply downward near the western edge of its outcrop and having discordant relations with the sediments beneath, not extending to the fault against the pre-Cambrian. The authors state that south of the Connecticut area the sandstones and shales become "greenish gray instead of red and brown." The sediments are chiefly red through New Jersey, Pennsylvania, Maryland, and Virginia. On the fossil plate (page 312), *Pseudomontis* should be *Pseudomonotis*.

It would seem more logical to illustrate clearly in the Jurassic chapter a reptile as distinctive as the ichthyosaur instead of showing a partial view on a plate with Cretaceous forms. The belemnoid type of cephalopod is not illustrated. *Rhychonella*, a brachiopod, is called a pelecypod.

For the Cretaceous, it would be well to show more characteristic echinoids, a group very important at that time. *Helicoceras*, one of the interestingly shaped cephalopods, is called a gastropod.

The Tertiary material is well-handled as to stratigraphy, but the discussion of life is inadequate. There is no general discussion of the main trends in mammalian evolution, no reference to the extremely interesting evolution of the horse. On page 412, *Eohippus* is called the "two-toed horse." The very abundant oreodonts are mentioned but not pictured. A misleading structural error appears in the caption for the picture of Tertiary sediments in the San Emigdio Canyon, Kern County, California, in which an obvious syncline is referred to as an "anticline."

The Quaternary Period is dealt with in an interesting way. There is more attention given to the stratigraphic distribution of Pleistocene sediments and vertebrate faunal zones in terrace fills than one usually encounters in such a text. The glacial history of the Great Lakes is neatly illustrated with four maps by Raisz.

All things considered, the reviewer feels that the quality and usefulness of this text would be much improved by a certain amount of revision with the purpose of adding some material and correcting the numerous errors.

FREDERICK P. YOUNG

Hunter College

Earth Science: The World We Live In. Samuel N. Namowitz, with the editorial assistance of Donald B. Stone. viii and 438 pp. D. Van Nostrand Co., Inc., New York, 1953. $3.96 .

The appearance of a new book embracing the earth sciences at the high-school level is of great interest to teachers in this field. *Earth Science: The World We Live In* will be especially welcomed because of its many excellent features. The book is organized into five units—the earth and its landforms, the universe, the atmosphere, the oceans, and climates—and includes an appendix on the earth's history. At the end of each chapter there are a number of aids, starting with a

summary called "Have you learned these?" and including questions, reading suggestions, and student activities. Admiration is excited by the specific character of the information given on a broad range of topics. A tremendous amount of material is packed into this text.

Nearly every page has one or more apposite illustrations, including a splendid selection of photographs, an outstanding feature of the book. Occasional diagrams suffer from over-simplification, examples being Fig. 8–14 showing the formation of a gorge by retreat of a waterfall, or Fig. 9–17 showing glacial deposits. The reduction of the rainfall map, Fig. 29–10, to such a small size–its legend and latitude figures cannot be read–detracts from its value as a learning device.

The book includes chapters on reading topographic maps; shorelines; conservation of water; flood prevention and soil preservation; physiographic regions of the United States; air masses; and fronts. These topics have been relatively neglected in textbooks for high schools, and hitherto the teacher has had to seek out pamphlets or advanced texts aimed at groups with different requirements. The need for a better understanding of the topic of shorelines may be judged by the space given, at the end of the chapter, to topic questions. In this chapter, as elsewhere, the author uses terminology and explanations in harmony with recent scientific authority.

Some errors will be noted by the geologist–for example, the illustration (Fig. 2–4) which confuses cleavage face and crystal face in the caption; and the statement on page 18 relating obsidian to the basalt series of igneous rocks when it properly belongs to the granite series by composition.

A necessarily brief presentation of fundamentals of scale and contour interval in the chapter on topographic maps is supplemented by mention of specific maps at the ends of the chapters where they apply.

In the chapters on the atmosphere, difficult concepts have been developed in such a manner that, if the explanations are followed step by step, they come within the grasp of the high-school student.

The problem of selecting material for emphasis in the "meaty," information-packed paragraphs that abound throughout the book is partially solved for the student by headings such as "Recipe for air," "Where does it rain," and "Where does it not rain." Judicious selection must be the function of the teacher who feels that the chapter on climate provides more than her pupils can profitably use.

The book should prove stimulating to teachers and pupils and should help to satisfy the currently rising interest in these aspects of the "world we live in."

CHARLOTTE PREUSS

Samuel J. Tilden High School
New York City

Physical Geology. L. Don Leet and Sheldon Judson. ix and 466 pp. Prentice-Hall, Inc., New York, 1954. $6.75 .

As geology becomes a more precise, quantitative science, in contrast to its earlier somewhat generalized descriptive character, it draws increasingly on other sciences for information to help explain observed phenomena. Yet few texts of el-

ementary physical geology contain appreciable amounts of background material from fields such as chemistry, physics, astronomy, and mathematics. Inasmuch as texts, by and large, reflect the wishes of instructors, could it be that we as teachers have been a bit slow to keep pace with the extensive developments since our college days in fields such as atomic chemistry, and so have been reluctant to attempt instruction of our students in such background information?

However this may be, *Physical Geology* by Leet and Judson is a new text which supplements its treatment of conventional geologic subjects with relevant information from other disciplines. It begins by explaining the wide and varied scope of geology, after which comes an 18-page resume of elementary atomic and and chemical theory, including such topics as atomic structure, electron energy levels, radioactivity, and ionic radii. Thus in the next chapter, when discussion begins on a conventional topic such as igneous rocks, the student is not floored as he meets, for instance, concepts of atomic arrangements involving space lattices and solid solution.

Succeeding chapters cover, in the order listed, weathering, sedimentary rocks, mass movement of surface material, running water, underground water, glaciation, work of the wind, the oceans, rock mobility and mountain building, earthquakes and the earth's interior, igneous activity and metamorphism, the earth's age and place in the universe, mineral deposits and fossil fuels. A 25-page glossary listing and briefly defining most of the geologic terms introduced in the text, and five appendices—on the elements, arithmetic fundamentals, geologic time divisions, minerals, and topographic maps—complete the text.

Here is a lucidly written, well-organized book which provides the basic fundamentals for both the student who may decide to specialize in geology and the one whose "interest" will end when he satisfies his college's minimum science requirement. Even for the latter, a text such as this is good, for it reveals science as a precise discipline, in which much work is amenable to accurate quantitative measurement. The text is refreshingly up-to-date and includes many references to recent work, as for instance that of Leopold and Maddock, who have shown that rivers may increase their velocities downstream, thus changing their erosion patterns. The physics also is modern. Ninety-eight known elements (through californium) are listed—a good batting average considering that numbers 99 and 100 were not announced until early 1954.

Over 350 well-planned pictures and drawings—many of them published for the first time—help fill the 466-page book. Each has a full caption and needs no supplementary text reference. Most technical terms, when first introduced, are not only defined, but their correct pronunciation is given. Also, their origin is noted. Is one of the authors at heart really an etymologist? A brief "Summary" ends each chapter, together with a list of "Selected References," most of which are of recent date except for classics such as William Morris Davis' "The Geographical Cycle."

Remarkably few errors or imperfections mar this excellent work. The reasons for some statements should be clarified. For instance, how do we know (page 379) that the moon's surface is covered with "coarse, gravel-sized fragments"? And why does the geologic time scale (appendix C, page 433) not list the Tertiary epochs? Also, how nice it would be if publishers used paper which would take ink without clogging a fine-point fountain pen!

But these are mere details. Of real importance is the appearance of a new text which treats introductory geology as a precise, scientific discipline, yet withal presents the subject matter in an interesting, lucid, up-to-date manner.

HALL TAYLOR

Columbia University

NOTES AND NEWS

NEWS OF THE ASSOCIATION. With the organization in April of a Far Western Section (California and Nevada), the Association of Geology Teachers now has five regional sections. A Southeastern Section (Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, Tennessee, North Carolina, and South Carolina) will soon be added.

The 1954 spring meetings of the sections were held as follows: Central on April 10, at the University of Missouri at Columbia; East Central on March 26–27, at the University of Kentucky at Lexington; Eastern on April 3–4, at Rutgers University, New Brunswick, New Jersey; New England on April 2–3, at the University of Vermont at Burlington; Far Western on April 3, at San Francisco State College, San Francisco, California.

CAREERS IN INDUSTRIAL MINERALS. The 176th General Annual Meeting of the American Institute of Mining and Metallurgical Engineers was held in New York City, February 15–18, 1954. On Tuesday, February 16, one of its sessions was devoted to a symposium on "Careers in Industrial Minerals." H. N. Bannerman and Sandford S. Cole served as associate chairmen. The following four papers were presented:

"Training for a Career in Industrial Minerals," by Raymond B. Ladoo, Consulting Mining Engineer.

"Mining Engineering in the Portland Cement Industry," by F. T. Agthe, Allis-Chalmers Manufacturing Co

"Experience in the Introduction of Talc as a Ceramic Material," by Henry Mulryan, Sierra Talc and Clay Co.

"Careers Related to Industrial Water," by Jack Graham.

On Sunday, February 14, at a session of the Minerals Industries Education Division, J. D. Forrester presented a paper on "What Qualifies a Geology Curriculum for Engineering Accreditation."

MORE GEOLOGISTS NEEDED. In this issue of the *Journal of Geological Education* John B. Lucke discusses some aspects of the problem our country faces "as the demand for trained geologists increases and the supply dwindles." That this problem is common to all sciences is pointed out by Howard A. Meyerhoff, executive director of the Scientific Manpower Commission, in an interview published in the *U. S. News and World Report*, January 15, 1954. Dr. Meyerhoff notes, however, that the percentage decrease in new students beginning graduate work in 1951 and 1952 was greatest—42 per cent—in the earth sciences. In the physical sciences as a whole the drop was 36 per cent, and in the biological sciences it was 30 per cent.

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